The documentation and process conversion measures necessary to comply with this document shall be completed by 10 May 2005

INCH-POUND

MIL-PRF-19500/251M
10 February 2005
SUPERSEDING
MIL-PRF-19500/251L
24 September 2003

* PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, SWITCHING, TYPES 2N2218, 2N2218A, 2N2218AL, 2N2219, 2N2219A, AND 2N2219AL, JAN, JANTX, JANTXV, AND JANS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

* The requirements for acquiring the product described herein shall consist of this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN, silicon, switching transistors. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (similar to TO-39, TO-5).

* 1.3 Maximum ratings unless otherwise specified T_A = +25°C.

Types	P_T T_A = +25°C (1)	P_T T_C = +25°C (1)	V_{CBO}	V_{CEO}	V_{EBO}	I_C	T_{STG} and T_J	$R_{\theta JC}$ max (2)	$R_{\theta JA}$ max (2)
	W	W	V dc	V dc	V dc	mA dc	For all	°C/W	°C/W
2N2218, 2N2219	0.8	3.0	60	30	5	800	-65° to	50	175
2N2218A, 2N2219A	0.8	3.0	75	50	6	800	+200°C	50	175
2N2218AL, 2N2219AL	0.8	3.0	75	50	6	800		50	175

(1) See derating curve figures 2 and 3.
(2) For thermal impedance curves see figures 4 and 5.

* Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dscc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database. http://assist.daps.dla.mil/quicksearch or http://assist.daps.dla.mil

1.4 Primary electrical characteristics.

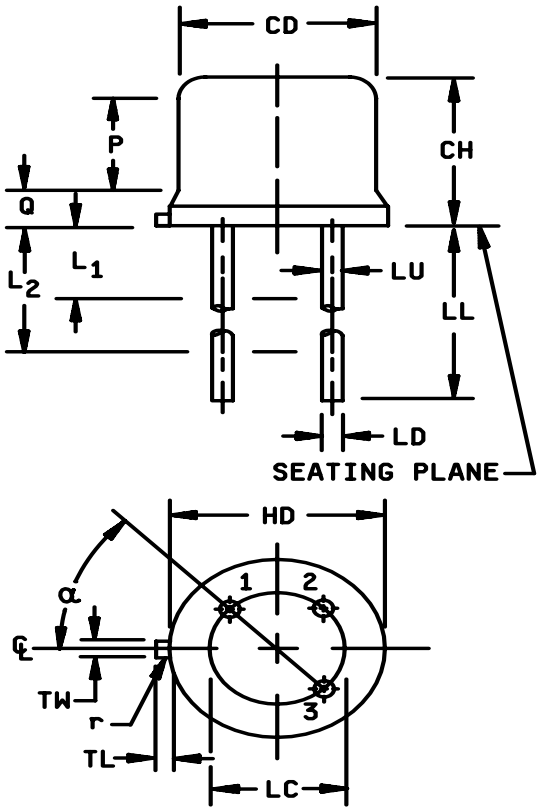
Types	h_{FE} at V_{CE} = 10 V dc									
	h_{FE1} I_C = 100 μA dc		h_{FE2} I_C = 1.0 mA dc		h_{FE3} I_C = 10 mA dc		h_{FE4} (1) I_C = 150 mA dc		h_{FE5} (1) I_C = 500 mA dc	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2N2218	20		25	150	35		40	120	20	
2N2219	35		50	325	75		100	300	30	
2N2218A	30		35	150	40		40	120	20	
2N2219A	50		75	325	100		100	300	30	
2N2218AL	30		35	150	40		40	120	20	
2N2219AL	50		75	325	100		100	300	30	

Types	$\lvert h_{fe} \rvert$ I_C = 20 mA dc V_{CE} = 20 V dc f = 100 MHz		C_{obo} I_E = 0, V_{CE} = 10 V dc 100 kHz ≤ f ≤ 1 MHz		Switching			
					t_{on}		t_{off}	
			pF		ns		ns	
	Min	Max	Min	Max	Min	Max	Min	Max
2N2218	2.5	12.0		8		40		250
2N2219	2.5	12.0		8		40		250
2N2218A	2.5	12.0		8		35		300
2N2219A	2.5	12.0		8		35		300
2N2218AL	2.5	12.0		8		35		300
2N2219AL	2.5	12.0		8		35		300

Types	$V_{CE(sat)1}$ (1) I_C = 150 mA dc I_B = 15 mA dc		$V_{CE(sat)2}$ (1) I_C = 500 mA dc I_B = 50 mA dc		$V_{BE(sat)1}$ (1) I_C = 150 mA dc I_B = 15 mA dc		$V_{BE(sat)2}$ (1) I_C = 500 mA dc I_B = 50 mA dc	
	V dc		V dc		V dc		V dc	
	min	max	min	max	min	max	min	max
2N2218		0.4		1.6	0.6	1.3		2.6
2N2219		0.4		1.6	0.6	1.3		2.6
2N2218A		0.3		1.0	0.6	1.2		2.0
2N2219A		0.3		1.0	0.6	1.2		2.0
2N2218AL		0.3		1.0	0.6	1.2		2.0
2N2219AL		0.3		1.0	0.6	1.2		2.0

(1) Pulsed (see 4.5.1).

Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
CH	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		7
LD	.016	.019	0.41	0.48	8,9
LL	See note 14				
LU	.016	.019	0.41	0.48	8,9
L1		.050		1.27	8,9
L2	.250		6.35		8,9
P	.100		2.54		7
Q		.030		0.76	5
TL	.029	.045	0.74	1.14	3,4
TW	.028	.034	0.71	0.86	3
r		.010		0.25	10
α	45° TP		45° TP		7



NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
7. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC.
8. Dimension LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
9. All three leads.
10. The collector shall be internally connected to the case.
11. Dimension r (radius) applies to both inside corners of tab.
12. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
13. Lead 1 = emitter, lead 2 = base, lead 3 = collector.
14. For L suffix devices (TO-5), dimension LL = 1.5 inches (38.10 mm) min. and 1.75 inches (44.45 mm) max. For non-L suffix types (TO-39), dimension LL = .5 inches (12.70 mm) min. and .750 inches (19.05 mm) max.

FIGURE 1. Physical dimensions (similar to TO-39, TO-5).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, and 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, and 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-750 - Test Methods for Semiconductor Devices.

* (Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturers list before contract award (see 4.2 and 6.3).

* 3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows.

PCB ..... Printed circuit board
$R_{\theta JA}$ ..... Thermal resistance junction to ambient.
$R_{\theta JC}$ ..... Thermal resistance junction to case.

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.5 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I.

3.6 Electrical test requirements. The electrical test requirements shall be as specified in table I.

3.7 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4, table I, and table II).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

* 4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not request the performance of table II tests, the tests specified in table II herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

* 4.3 Screening. Screening shall be in accordance with table IV of MIL-PRF-19500 and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
3c	Thermal impedance (see 4.3.2).	Thermal impedance (see 4.3.2).
7	Optional	Optional
9	I_{CBO2}, h_{FE2}	Not applicable
10	48 hours minimum	48 hours minimum
11	I_{CBO2}; h_{FE4}; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater. Δh_{FE4} = ±15 percent	I_{CBO2}, h_{FE4}
12	See 4.3.1	See 4.3.1
13	Subgroups 2 and 3 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE4} = ±15 percent	Subgroup 2 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE4} = ±15 percent
14	Required	Required

4.3.1 Power burn-in test conditions. Power burn-in conditions are as follows: V_{CB} = 10 - 30 V dc. Power shall be applied to achieve T_J = +135°C minimum using a minimum P_D = 75 percent of P_T maximum T_A ambient rated as defined in 1.3. With approval of the qualifying activity and preparing activity alternate burn-in criteria (hours, bias conditions, TJ, and mounting conditions) maybe used. A justification demonstrating equivalence is required. In addition the manufacturing site's burn-in data and performance history will be essential criteria for burn-in modification approval. This optional is limited to plants who are at least transitional (QML) approved or have an approved technical review board (TRB).

4.3.2 Thermal impedance (measurements). The thermal impedance measurements shall be performed in accordance with method 3131 of MIL-STD-750 using the guidelines in that method for determining I_M, I_H, t_H, t_{MD} (and V_C where appropriate). The thermal impedance limit used in 4.3, screen 3c shall comply with the thermal impedance graph in figures 4 and 5 (less than or equal to the curve value at the same t_H time) and shall be less than the process determined statistical maximum limit as outlined in method 3131 of MIL-STD-750.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. If alternate screening is being performed in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of table I, group A1 and A2 inspection only (table VIb, group B, subgroup 1 is not required to be performed again if group B has already been satisfied in accordance with 4.4.2 herein).

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIa (JANS) of MIL-PRF-19500 and 4.4.2.1. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 and 4.5.3 herein. See 4.4.2.2 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) and delta requirements for JAN, JANTX, and JANTXV shall be after each step in 4.4.2.2 and shall be in accordance with table I, subgroup 2 and 4.5.3 herein.

4.4.2.1 Group B inspection (JANS), table VIa of MIL-PRF-19500.

Subgroup	Method	Condition
B4	1037	V_{CB} = 10 V dc.
B5	1027	V_{CB} = 10 V dc; $P_D \geq$ 100 percent of maximum rated P_T (see 1.3). (NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.) Option 1: 96 hours minimum sample size in accordance with MIL-PRF-19500, table VIa, adjust T_A or P_D to achieve T_J = +275°C minimum. Option 2: 216 hours minimum, sample size = 45, c = 0; adjust T_A or P_D to achieve a T_J = +225°C minimum.

* 4.4.2.2 Group B inspection, (JAN, JANTX, and JANTXV). Separate samples may be used for each step. In the event of a lot failure, the resubmission requirements of MIL-PRF-19500 shall apply. In addition, all catastrophic failures during CI, conformance inspection, shall be analyzed to the extent possible to identify root cause and corrective action.

Step	Method	Condition
1	1026	Steady-state life: 1,000 hours minimum, V_{CB} = 10 V dc, power shall be applied to achieve T_J = +150°C minimum using a minimum of P_D = 75 percent of maximum rated P_T as defined in 1.3. n = 45 devices, c = 0. The sample size may be increased and the test time decreased as long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.
2	1048	Blocking life, T_A = +150°C, V_{CB} = 80 percent of rated voltage, 48 hours minimum. n = 45 devices, c = 0.
3	1032	High-temperature life (non-operating), t = 340 hours, T_A = +200°C. n = 22, c = 0.

4.4.2.3 Group B sample selection. Samples selected from group B inspection shall meet all of the following requirements:

a. For JAN, JANTX, and JANTXV, samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. For JANS, samples shall be selected from each inspection lot. See MIL-PRF-19500.

b. Must be chosen from an inspection lot that has been submitted to and passed table I, subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (subgroups B4 and B5 for JANS, and group B for JAN, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

* 4.4.3 Group C inspection, Group C inspection shall be conducted in accordance with the test and conditions specified for subgroup testing in table VII of MIL-PRF-19500, and in 4.4.3.1 (JANS) and 4.4.3.2 (JAN, JANTX, and JANTXV) herein for group C testing. Electrical measurements (end-points) and delta requirements shall be in accordance with table I, subgroup 2 and 4.5.3 herein; delta requirements only apply to subgroup C6.

* 4.4.3.1 Group C inspection (JANS), table VII of MIL-PRF-19500.

Subgroup	Method	Condition
C2	2036	Test condition E; (not applicable for UA and UB devices).
C5	3131	$R_{\theta JA}$ and $R_{\theta JC}$ only, as applicable (see 1.3) and applied thermal impedance curves.
C6	1026	1,000 hours at V_{CB} = 10 V dc; power shall be applied to achieve T_J = +150°C minimum and a minimum of P_D = 75 percent of maximum rated P_T as defined in 1.3 n = 45, c = 0. The sample size may be increased and the test time decreased as long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.

* 4.4.3.2 Group C inspection (JAN, JANTX, and JANTXV), table VII of MIL-PRF-19500.

Subgroup	Method	Condition
C2	2036	Test condition E.
C5	3131	$R_{\theta JA}$ and $R_{\theta JC}$ only, as applicable (see 1.3).
C6		Not applicable.

* 4.4.3.3 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any inspection lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes table I tests herein for conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for C6 life test may be pulled prior to the application of final lead finish. Testing of a subgroup using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500 and as specified in table II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein; delta measurements shall be in accordance with the applicable steps of 4.5.3.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3131 of MIL-STD-750. The maximum limit of $R_{\theta JC(max)}$ shall be 50°C /W. The following test conditions shall apply:

a. I_C: Collector current ..... 90 mA.

b. V_{CE}: Measurement voltage (same as V_H) ..... 10 V.

c. I_H: Collector heating current..... 90 mA.

d. V_H: Collector-emitter heating voltage ..... 10 V.

e. t_H: Heating time ..... 1.0 s.

f. t_{MD}: Measurement delay time ..... 30 to 60 μs.

g. t_{SW}: Sampling window time ..... 10 μs max.

4.5.3 Delta requirements. Delta requirements shall be as specified below:

Step	Inspection	MIL-STD-750		Symbol	Limit	Unit
		Method	Conditions			
1	Collector-base cutoff current 2N2218, 2N2219 2N2218A, 2N2219A 2N2218AL, 2N2219AL	3036	Bias condition D, V_{CB} = 50 V dc V_{CB} = 60 V dc V_{CB} = 60 V dc	ΔI_{CB02} (1)	100 percent of initial value or 10 nA dc, whichever is greater.	
2	Forward current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 1.0 mA dc; pulsed see 4.5.1.	Δh_{FE2} (1)	25 percent change from initial reading.	

(1) Devices which exceed the group A limits for this test shall not be accepted.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical examination 3/	2071	n = 45 devices, c = 0				
Solderability 3/ 4/	2026	n = 15 leads, c = 0				
Resistance to solvents 3/ 4/ 5/	1022	n = 15 devices, c = 0				
Electrical measurements 4/		Table I, subgroup 2				
Temp cycling 3/ 4/	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic seal 4/ 6/	1071	n = 22 devices, c = 0				
Fine leak						
Gross leak						
Electrical measurements 4/		Table I, subgroup 2				
Bond strength 3/ 4/	2037	Precondition T_A = +250°C at t = 24 hours or T_A = +300°C at t = 2 hours n = 11 wires, c = 0				
Decap internal visual (design verification) 4/	2075	n = 4 devices, c = 0				
Subgroup 2						
Thermal impedance	3131	See 4.3.2	$Z_{\theta JX}$			°C/W
Collector to base cutoff current	3036	Condition D	I_{CBO1}			
2N2218, 2N2219		V_{CB} = 60 V dc			10	µA dc
2N2218A, 2N2219A		V_{CB} = 75 V dc			10	µA dc
2N2218AL, 2N2219AL		V_{CB} = 75 V dc			10	µA dc
Emitter to base cutoff current	3061		I_{EBO1}			
2N2218, 2N2219		V_{EB} = 5 V dc			10	µA dc
2N2218A, 2N2219A		V_{EB} = 6 V dc			10	µA dc
2N2218AL, 2N2219AL		V_{EB} = 6 V dc			10	µA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; IE = 10 mA dc; pulsed (see 4.5.1).	$V_{(BR)CEO}$			
2N2218, 2N2219				30		V dc
2N2218A, 2N2219A				50		V dc
2N2218AL, 2N2219AL				50		V dc

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - Continued						
Collector to emitter cutoff current	3041	Bias condition C	I_{CES}			
2N2218, 2N2219		V_{CE} = 30 V dc			10	nA dc
2N2218A, 2N2219A		V_{CE} = 50 V dc			10	nA dc
2N2218AL, 2N2219AL		V_{CE} = 50 V dc			10	nA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4 V dc	I_{EBO2}		10	nA dc
Collector to base cutoff current	3036	Bias condition D	I_{CBO2}			
2N2218, 2N2219		V_{CB} = 50 V dc			10	nA dc
2N2218A, 2N2219A		V_{CB} = 60 V dc			10	nA dc
2N2218AL, 2N2219AL		V_{CB} = 60 V dc			10	nA dc
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 0.1 mA dc; pulsed (see 4.5.1)	h_{FE1}			
2N2218				20		
2N2219				35		
2N2218A, 2N2218AL				30		
2N2219A, 2N2219AL				50		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 1.0 mA dc; pulsed (see 4.5.1)	h_{FE2}			
2N2218				25	150	
2N2219				50	325	
2N2218A, 2N2218AL				35	150	
2N2219A, 2N2219AL				75	325	
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc; pulsed (see 4.5.1)	h_{FE3}			
2N2218				35		
2N2219				75		
2N2218A, 2N2218AL				40		
2N2219A, 2N2219AL				100		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc; pulsed (see 4.5.1)	h_{FE4}			
2N2218				40	120	
2N2219				100	300	
2N2218A, 2N2218AL				40	120	
2N2219A, 2N2219AL				100	300	
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 500 mA dc; pulsed (see 4.5.1)	h_{FE5}			
2N2218				20		
2N2219				30		
2N2218A, 2N2218AL				20		
2N2219A, 2N2219AL				30		

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - Continued						
Collector-emitter saturation voltage	3071	I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$			
2N2218, 2N2219					0.4	V dc
2N2218A, 2N2219A					0.3	V dc
2N2218AL, 2N2219AL					0.3	V dc
Collector-emitter saturation voltage	3071	I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$			
2N2218, 2N2219					1.6	V dc
2N2218A, 2N2219A					1.0	V dc
2N2218AL, 2N2219AL					1.0	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)1}$			
2N2218, 2N2219				0.6	1.3	V dc
2N2218A, 2N2219A				0.6	1.2	V dc
2N2218AL, 2N2219AL				0.6	1.2	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)2}$			
2N2218, 2N2219					2.6	V dc
2N2218A, 2N2219A					2.0	V dc
2N2218AL, 2N2219AL					2.0	V dc
Subgroup 3						
High temperature operation		T_A = +150°C				
Collector to base cutoff current	3036	Bias condition D	I_{CBO3}		10	μA dc
2N2218, 2N2219		V_{CB} = 50 V dc				
2N2218A, 2N2219A		V_{CB} = 60 V dc				
2N2218AL, 2N2219AL		V_{CB} = 60 V dc				
Low temperature operation		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc	h_{FE6}			
2N2218, 2N2219				15		
2N2218A, 2N2219A				35		
2N2218AL, 2N2219AL				35		

See footnotes at end of table.

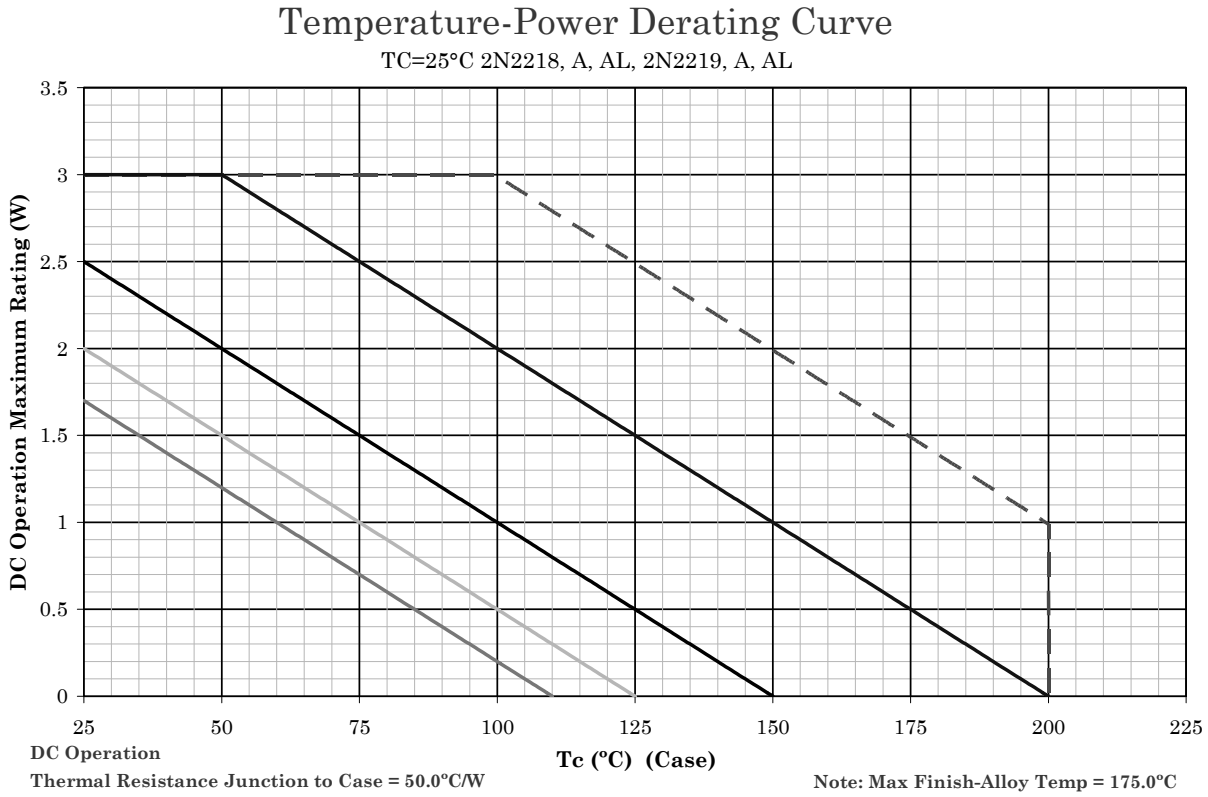
* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 4						
Magnitude of common emitter small-signal short- circuit forward current transfer ratio	3306	V_{CE} = 20 V dc; I_C = 20 mA dc; f = 100 MHz	$\lvert h_{fe} \rvert$	2.5	12	
Small-signal short-circuit forward current transfer ratio	3206	V_{CE} = 10 V dc; I_C = 1 mA dc; f = 1 kHz	h_{fe}			
2N2218				25		
2N2219				50		
2N2218A, 2N2218AL				35		
2N2219A, 2N2219AL				75		
Open circuit output capacitance	3236	V_{CB} = 10 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{obo}		8	pF
Open circuit output capacitance	3240	V_{EB} = 0.5 V dc; I_C = 0; 100 kHz ≤ f ≤ 1 MHz	C_{ibo}		25	pF
Saturated turn-on time		(See figure 6)	t_{on}			
2N2218, 2N2219					40	ns
2N2218A, 2N2219A					35	ns
2N2218AL, 2N2219AL					35	ns
Saturated turn-off time		(See figure 7)	t_{off}			
2N2218, 2N2219					250	ns
2N2218A, 2N2219A					300	ns
2N2218AL, 2N2219AL					300	ns
Subgroups 5 and 6						
Not applicable						

1/ For sampling plan see MIL-PRF-19500.
2/ For resubmission of failed subgroup 1, double the sample size of the failed test or sequence of tests. A failure in group A, subgroup 1 shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.
3/ Separate samples may be used.
4/ Not required for JANS devices.
5/ Not required for laser marked devices.
6/ This hermetic seal test is an end-point to temp-cycling in addition to electrical measurements.

* TABLE II. Group E inspection (all quality levels) - for qualification or re-qualification only.

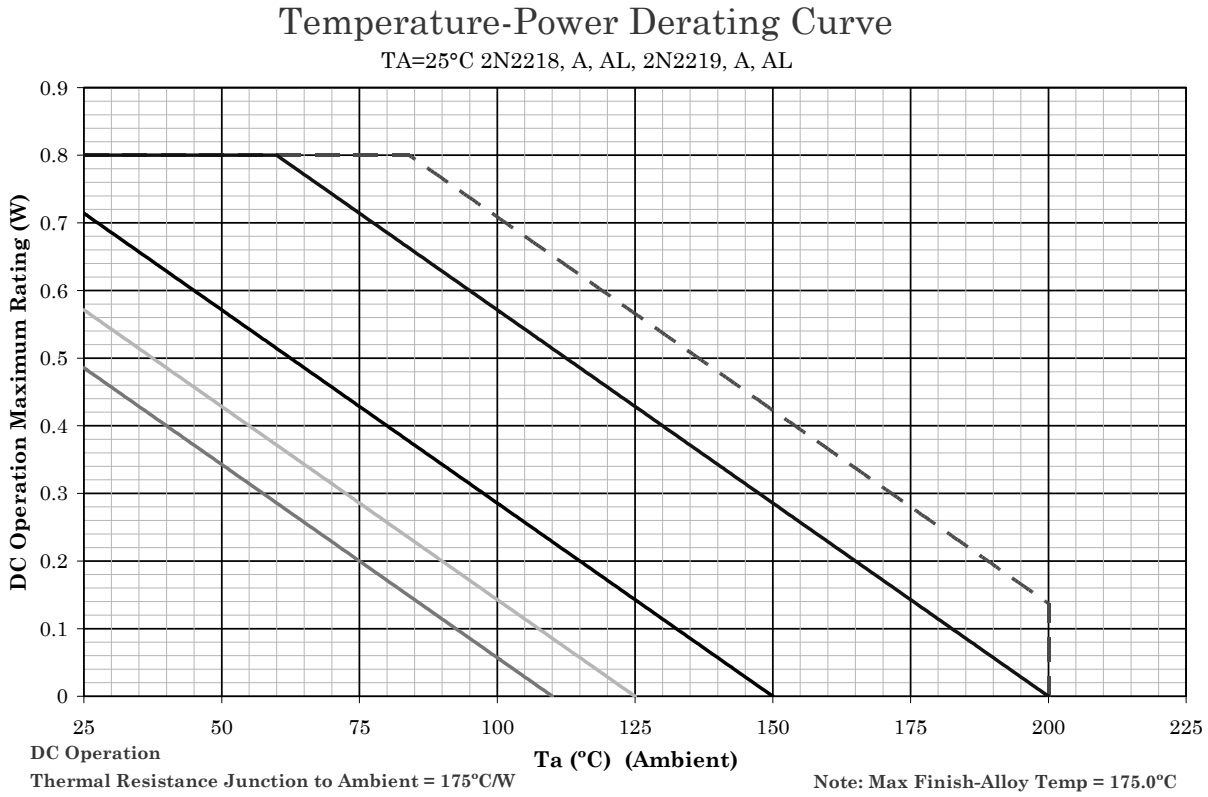
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2 and 4.5.3 herein.	
Subgroup 2			45 devices c = 0
Intermittent life	1037	V_{CB} = 10 V dc, 6,000 cycles, forced air cooling allowed on cooling cycle only	
Electrical measurements		Table I, subgroup 2 and 4.5.3 herein.	
Subgroup 4			
Thermal impedance curves		Each supplier shall submit their qualification lot average design maximum thermal impedance curves to the qualifying activity. In addition, the optimal test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report.	Sample size N/A
Subgroup 5			
Not applicable			
Subgroup 6			3 devices
Electrocstatic discharge (ESD)	1020		
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition B.	



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve since it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures the device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
2. Derate design curve constrained by the maximum junction temperature ($T_J \leq 200°C$) and power rating specified. (See 1.3 herein.)
3. Derate design curve chosen at $T_J \leq 150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq 125°C$, and 110°C to show power rating where most users want to limit T_J in their application.

* FIGURE 2. Derating for 2N2218, 2N2218A, 2N2218AL, 2N2219, 2N2219A, and 2N2219AL ($R_{\theta JC}$) (TO-39 and TO-5).



NOTES:

1. Top curve is thermal runaway loci and cannot be used as a derate design curve since it exceeds the maximum ratings for this part. Operating under this curve using these mounting conditions assures the device will not have a thermal runaway. This is the true inverse of the worst case thermal resistance value extrapolated out to the thermal runaway point.
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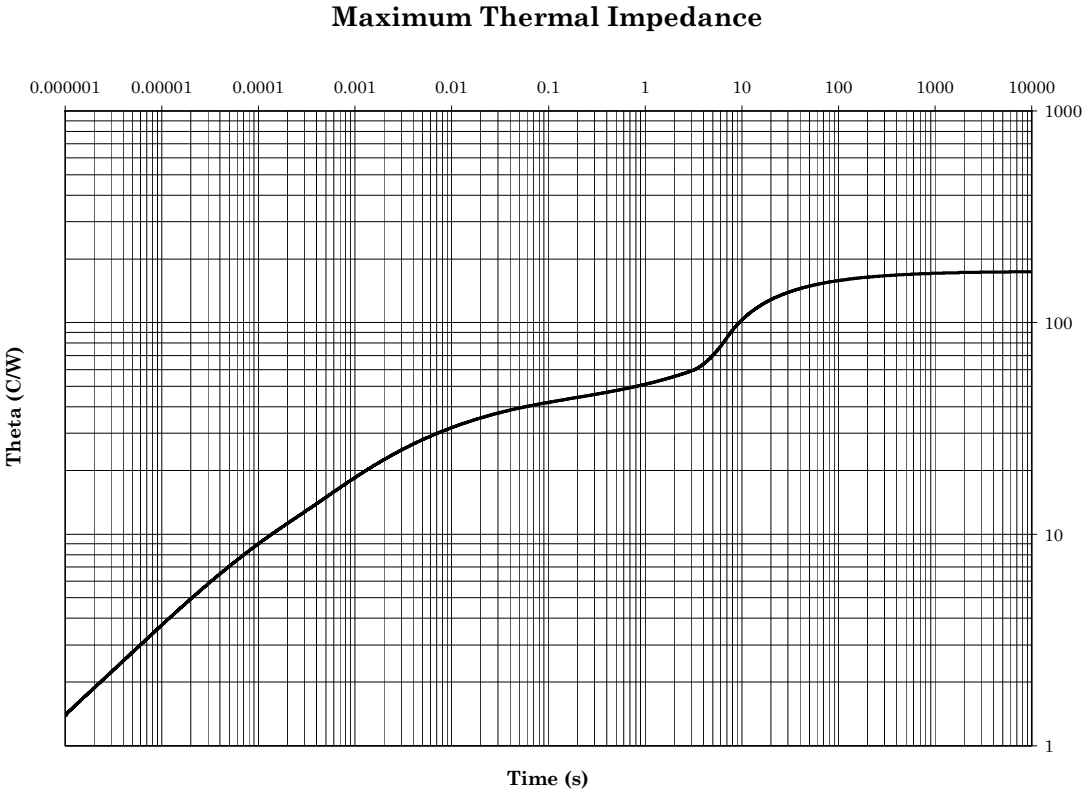
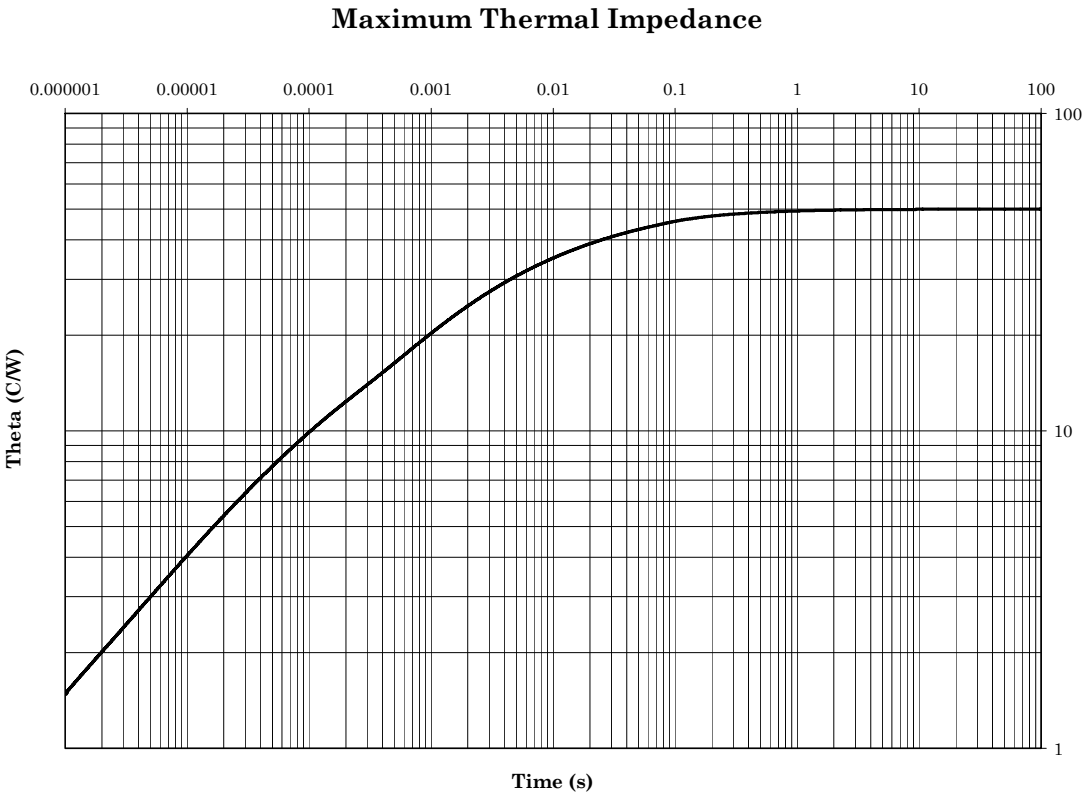
4. Derate design curve chosen at $T_J \leq 125°C$, and 110°C to show power rating where most users want to limit T_J in their application.

* FIGURE 3. Derating for 2N2218, 2N2218A, 2N2218AL, 2N2219, 2N2219A, and 2N2219AL ($R_{\theta JA}$) (TO-39 and TO-5).



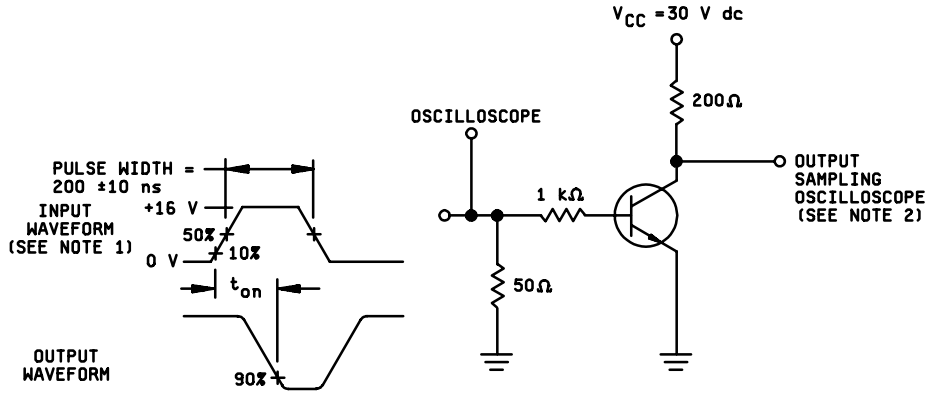
T_A = +25°C, 800 mW, Thermal resistance $R_{\theta JA}$ = 175°C/W

* FIGURE 4. Thermal impedance graph ($R_{\theta JA}$) for 2N2218, 2N2218A, 2N2218AL, 2N2219, 2N2219A, and 2N2219AL (TO-39 and TO-5).



T_C = +25°C, Thermal resistance $R_{\theta JC}$ = 50°C/W

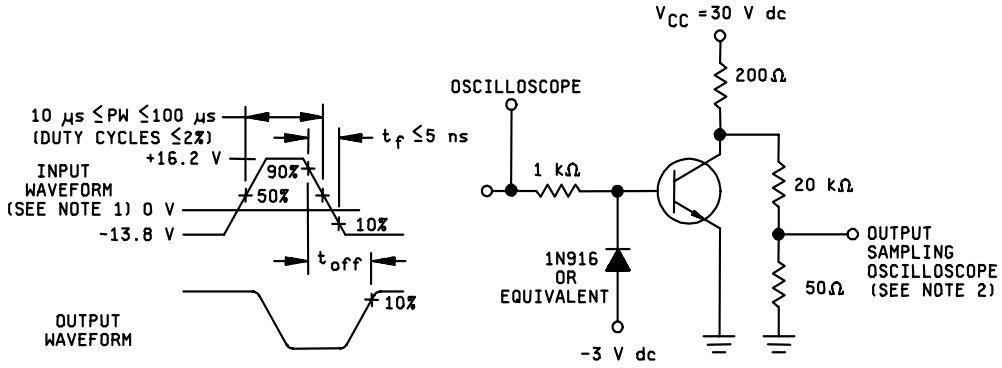
* FIGURE 5. Thermal impedance graph ($R_{\theta JC}$) for 2N2218, 2N2218A, 2N2218AL, 2N2219, 2N2219A, and 2N2219AL (TO-39 and TO-5).



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 2.0 ns, duty cycle ≤ 2 percent and the generator source impedance shall be 50 ohms.
2. Sampling oscilloscope: Z_{in} ≥ 100 K ohms, C_{in} ≤ 12 pF, rise time ≤ .2 ns.

* FIGURE 6. Saturated turn-on switching time test circuit.



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 2.0 ns, duty cycle ≤ 2 percent and the generator source impedance shall be 50 ohms.
2. Sampling oscilloscope: Z_{in} ≥ 100 K ohms, C_{in} ≤ 12 pF, rise time ≤ .2 ns.

* FIGURE 7. Saturated turn-off switching time test circuit.

5. PACKAGING

* 5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

* 6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Packaging requirements (see 5.1).

c. Lead finish (see 3.4.1).

d. Product assurance level and type designator.

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML 19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil.

6.4 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 11
NASA - NA
DLA - CC

Review activities:
Army - AR, MI, SM
Navy - AS, MC, SH
Air Force - 19, 71, 99

Preparing activity:
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